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CONTENTS

The Editor's Page 299

An Example of Co-operative Research 300

Fundamental Properties of Textile Wastes. (*A Textile Foundation Publication.*) V. Flotation from Ferric Oxide Sols. B. Reid Clanton 301

VI. Electrophoresis of Platinum and Gold Hydrosols. James E. Magoffin and H. Temple Hatch 305

Resiliency and Density of Some Upholstery Plant Fibres: Investigations on. Brittain B. Robinson 310

Some Production and Biological Aspects of Cotton Quality. H. W. Barre 317

Abstracts 323

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MEMBERSHIPS

New Members of the Institute whose applications are received between July 1 and Oct. 1, 1938, will be billed as of Oct. 1, but will qualify for all membership privileges and services as of the date the membership application is received. This offer of free membership until Oct. 1, 1938, is correlated with present business conditions, and with the Institute's need of a large increase in membership.

Contributing Membership Dues are to be reduced as of Oct. 1, in accordance with the amended by-laws, from $100 to $50. Only this class of membership will then have the privilege of subscribing to co-operatively financed researches and of receiving progress reports of the latter. The reasons for these changes were explained in the June issue of *Textile Research*.

In accordance with an order of President Killheffer, each member of the Institute is a Committee of One on Membership. For membership booklet, membership application blanks, etc., address the Secretary.

ADVERTISEMENTS
IN
TEXTILE RESEARCH

Advertisements are solicited for special front and back sections of this publication.

This new policy is to provide income for increased expenses, and it is hoped that revenue from advertising may be large enough to make this a larger and more adequate scientific textile publication, and also sufficient to provide a surplus for research financing.

For advertising rates, for space available, including a special section for professional cards, and for other information in these connections, address:

C. H. CLARK, Secretary

United States Institute for Textile Research, Inc.

65 Franklin St., Boston, Mass.

The Editor's Page

Dr. H. A. Neville, a member of the Administration Committee for the Institute's warp sizing research, has been made professor and head of the Department of Chemistry and Chemical Engineering, Lehigh University, Bethlehem, Pa. He has been with that department since 1927.

* * *

Edward T. Pickard, secretary and assistant treasurer of the Textile Foundation, and chief of the Textile Section of the Bureau of Foreign and Domestic Commerce, Department of Commerce, is recuperating from a protracted sickness at his old home in Kent, Conn., and expects to be at work again in July.

* * *

Franklin W. Hobbs, president, Arlington Mills, Boston, Mass., has received from President Roosevelt his appointment for a third term of four years as Chairman of the Textile Foundation. Mr. Hobbs was originally appointed by Former-President Hoover in 1930, thus emphasizing the non-political character of the office. His service without salary, and his able administration of the affairs of the Foundation, demonstrate his belief in the industry's need of research, and his willingness to make unusual sacrifices of time and labor for its attainment.

* * *

More tangible evidence of the fruition of the educational program of The Textile Foundation than has been presented to the industry generally since the publication of its report on "The Training of Men for the Textile Industry," is now available in a series of text books on textile economics. There are four of this series: Management of a Textile Business; Textile Costing—An Aid to Management; Marketing of Textiles; The Textile Industries—An Economic Analysis. The text material was prepared by members of the staff of the Wharton School of Finance and Commerce, University of Pennsylvania, under the direction of Dr. Alfred H. Williams, Professor of Industry, and the work was underwritten by the Foundation. While the books were written to provide business background for textile school and college students, their scope is so wide and informative that they should prove equally valuable to mill employees engaged in minor executive and supervisory work. Under the Book Review section of the June issue of TEXTILE RESEARCH will be found brief reviews of each volume. To make possible their widest possible use the Foundation has made them available at actual cost of publication, or only $2.00 per volume and $6.00 for the set of four books.

* * *

Scarcely less important than results to a well-rounded system of scientific research are the program and methods employed. One of the pur-

poses of this magazine is not only to inform its readers as to textile research accomplishments throughout the world, and particularly of results of original research in this country, but also of research needs, programs, and methods. Of the latter character is a series of three papers presented at the March meeting in Washington, D. C., of Sub-committee A 1, Section 1 on Raw Cotton, of Committee D–13 of the A. S. T. M., of which sub-committee Dr. R. W. Webb, principal cotton technologist, Division of Cotton Marketing, Bureau of Agricultural Economics, is chairman. With Dr. Webb's co-operation the first paper of this series, by M. E. Campbell, appeared in the June issue of *Textile Research*. It is followed in this issue by a paper by Dr. H. W. Barre, in charge of the Cotton Division of the Bureau of Plant Industry, on "Some Production and Biological Aspects of Cotton Quality," and will conclude in the August issue with a paper on "Cross-sectional and Related Structural Features of Cotton Fibres Influencing Quality," by Dr. Enoch Karrer, Senior Cotton Technologist, Bureau of Agricultural Economics. The work and findings described in these papers constitute a part of the broad Federal-State cotton research program that is being sponsored and conducted by several bureaus of the U. S. Department of Agriculture through close co-operation and co-ordination.

* * *

An Example of Co-operative Research

"Vertical Integration in the Textile Industries," the first of the Institute's co-operative researches to be completed and published, although the second to have been started, had its formal presentation to co-operators and to the Press at an informal luncheon given by The Textile Foundation, which financed the study, at the Merchant's Club, New York City, June 29. Complimentary copies of the book were presented to those in attendance, and ways and means were discussed for getting the widest possible distribution for the book among members of the industry. While a review of the book is not available at this writing, the importance of the subject, the broad scope of the survey, and the expert analysis and interpretation of the experiences and facts gathered by the economists of the Wharton School of Finance and Commerce, should ensure a large demand for the book were the price per copy several times the $1.50 at which it has been made available by The Textile Foundation.

Because this book is the result of an outstanding example of co-operative research, repetition of a few facts regarding its origin, financing and conduct may be pardonable: The plan was developed by the Committee on Economic Research of U. S. Institute for Textile Research, of which committee Fessenden S. Blanchard is chairman, was presented to and received the endorsement of the heads of 12 leading textile associations, was then submitted to The Textile Foundation, which agreed to finance it provided the committee and a small advisory board of association heads would select a place and staff for the conduct of the study under their supervision. The Wharton School of Finance and Commerce, of which Dr. Joseph H. Willits is dean, was selected for the work and has been engaged thereon for some two years. The Textile Foundation granted $20,000 for the

(*Continued on page 304.*)

Fundamental Properties of Textile Wastes. V. Flotation from Ferric Oxide Sols.

By B. REID CLANTON *

A Textile Foundation Publication

Introduction

THE theoretical concepts regarding flotation have been reviewed in an earlier paper,[1] in which it was pointed out that little work has been done on the flotation of particles of colloidal size, although the problem has presented itself in many instances. There appears to be no reason why such particles cannot be removed from a liquid medium by flotation methods.

Hydrous ferric oxide, the substance chosen first for investigation, is a hydrophylic sol in which the particles are positively charged. Any agent which will successfully float Fe_2O_3 must adhere to the Fe_2O_3 particles and form a water repellent coating. Sodium oleate should be a good floating agent for Fe_2O_3 because in solution the oleate ion is negatively charged, and therefore should be strongly attracted to the ferric oxide particles; and the long olefin chain of the oleate ion should be highly water repellent. For the same reasons sodium benzoate and the "Gardinols" should be suitable floating agents.

The Apparatus

The apparatus used in these experiments consisted of a 40-liter drum, fitted with a manometer, and two air lines of glass tubing, running from the drum to each of two glass cylinders or flotation cells. In each cell was a bubbler made by sealing a sintered glass plate to a piece of glass tubing. The drum acted as a stabilizer allowing a steady pressure to be maintained. A control valve placed between the drum and the air line permitted the pressure to be regulated easily. A stopcock was placed in each line running to the cells in order that they might be operated separately or together. The apparatus is extremely simple in design, construction, and operation; but also, it is efficient, giving a steady flow of air, the pressure of which can be controlled within one millimeter of mercury.

Experiments

The ferric oxide was made as suggested by Sorum.[3] Eighty cc. of a one molar solution of ferric chloride were dropped at the rate of about two drops per second into a liter of boiling water. The slowness of addition of the ferric chloride to the water was to insure complete hydrolysis. The re-

* Mr. Clanton is a Junior Investigator of the Textile Foundation working under the direction of Dr. Frank K. Cameron at the University of North Carolina, Chapel Hill, N. C.

agents sodium oleate, sodium benzoate, and the "Gardinol" were made in 5% solutions.

The ferric oxide was diluted with distilled water to the desired concentration and added directly to the cell. A pressure of 2.5 cm. on a mercury manometer gave a steady flow of air, so this convenient pressure was used in most of the experiments. All reagents were added from a burette placed just above the cell, and, in most instances, additions were in small quantities with sufficient time allowed between each addition to insure completeness of its action. The same volume of sol was diluted with 100 cc., 200 cc., and 500 cc. of water. The variation in the quantity of water had no effect on the amount of reagent required for complete flotation, so all the experiments were run at the convenient volume of 500 cc.

A sodium oleate solution was made up containing 1 cc. of concentrated ammonium hydroxide to 50 cc. of sodium oleate, and this solution was used as a reagent in the usual manner. The increased alkalinity produced an abundant froth but the flotation was not successful. Even with a very small addition of ammonium hydroxide the results were poor.

Kerosene was used as a collector with all the reagents tried. There was a kerosene coating on the particles precipitated by the sodium oleate and on those precipitated by the "Gardinol." Additions to the sodium benzoate proved detrimental to flotation.

Runs were made using the same water to dilute the solution on successive experiments. This was done to recover any reagents that were present in excess and to prove the feasibility of re-using the water in such instances as this might be desirable.

Some discussion has arisen in the past as to the importance of the gas phase in flotation. In order to settle this question for the flotation of colloidal substances, experiments were made in which the gas phase was excluded. The water used was boiled under reduced pressure for 8 hours to remove all the dissolved gases. It was found that the sol made with air-free water could be precipitated by the sodium benzoate and the "Gardinol" while stirring rapidly with a mechanical stirrer, but not floated. This charge of precipitated ferric oxide was placed in the cell and floated. When the experiment was tried with sodium oleate as the precipitating agent, flotation occurred although the

TABLE I

Flotation of Ferric Oxide

Fe_2O_3 Sol cc.	Reagent 5%	Reagent Used cc.	Pressure cm. Hg
25	Sodium Oleate	31.0	2.5
50	" "	62.0	"
100	" "	112.0	"
25	Sodium Benzoate	28.0	"
50	" "	50.0	"
100	" "	71.0	"
25	"Gardinol"	1.8	"
50	"	8.0	"
25	" *	53.0	"
25	"Gardinol" and 2 cc. Kerosene	13.0	"
25	" " 1 cc. "	6.1	2.1

*0.5%.

stirring was not vigorous enough to whip air into the solution. To remove the possibility that the air was being whipped in from outside, the charge was placed in a flask which was evacuated with a water pump. Upon agitation, flotation occurred. The solution, water and reagent were refluxed under reduced pressure, as described previously, and the flotation was tried in the same manner as above. No flotation was secured on this trial.

Discussion of Results

The process was considered a failure unless all the suspended matter had been floated out and the remaining liquid was clear. Tests were made with NH_4CNS to determine if all the iron had been removed. In all runs recorded in the tables no positive iron tests were found except in the case of "Gardinol." The iron remaining in this instance was in true solution and not as a colloid.

The sodium cleate precipitated the colloidal ferric oxide and floated it, leaving a clear solution that gave no positive test for iron when treated with NH_4CNS. The floated particles collected in a red sticky mass that was quite water repellent, and to which air was strongly attracted. Some difficulty was encountered in many of the early attempts because an excess of sodium oleate was present. This excess actually prevented flotation, in some cases by acting as a peptizing agent. NaCl or NaOH added to the solution precipitated the excess cleate removing the peptizing agent and allowing the ferric oxide to precipitate. This situation was avoided by adding the reagent cautiously from a burette.

The "Gardinol" precipitates and floats the ferric oxide readily and produces an abundant froth. Because of this, the particles are carried off so rapidly that no collection occurs to make the froth heavy. If the froth can be heavily coated, the bubbles become overloaded and break. Then the next layer becomes more concentrated and excessive frothing is prohibited at the same time. The manner in which the "Gardinol" was added had an effect on the quantity required. If the additions were small, more of the "Gardinol" was required than when the larger portions were added. The precipitated particles did not possess a coating like that found when sodium oleate was used. They were water repellent but not so much so as those formed when oleate was used. From a consideration of the structure of the oleate ion and that part of the "Gardinol" exposed to the water, such results are to be expected. The "Gardinol" possesses 12 carbon atoms which act as a hydrophobic coating, whereas the oleate has 18 carbons. While the solution remained fairly concentrated, the "Gardinol" removed the suspended ferric oxide with little difficulty, but was not very satisfactory with a very dilute solution. A little kerosene added to the solution gave the precipitated particles a more water repellent coating and proved to be an efficient collecting agent. The combination of "Gardinol" and kerosene worked best when the pressure was lowered.

Sodium benzoate produced a coating similar to that of the "Gardinol." Frothing was plentiful but the foam was heavily laden with the precipitated particles. This lent such persistency to the foam that it stood up for days. As with the "Gardinol," results were somewhat more difficult to repeat than with the oleate. Here, too, the manner of addition affected the quantity required in the same way as was found with the "Gardinol." Because the amount of reagent used did not vary in proportion to the concentration of the

solution, there is evidently a "clumping" of the particles and, hence, a reduction in amount of reagent required.

One of the most interesting facts to come to our attention was the importance of the gas phase in flotation. As noted previously, the "Gardinol" and sodium benzoate precipitated the solution while it was stirred vigorously, but they would not float it. When this experiment was tried with the sodium oleate flotation occurred and the floated particles were filled with air bubbles. Either the stirrer had beaten air into the solution or dissolved gases had precipitated onto the coated particles. The experiment was repeated in an evacuated flask and flotation occurred again. The water, solution, and reagent were refluxed under reduced pressure and another trial was made in the evacuated flask. No flotation was obtained and some settling was noticed. This seems to bear out the idea advanced by Welsh [5] that it is the dissolved gas which is important to flotation. In all probability dissolved gases do precipitate onto the coated particles but not in sufficient quantity to give complete flotation. Taggart [4] and Gaudin [2] give little treatment to the gas phase but the necessity of its presence in flotation must not be overlooked.

Summary

The positively charged, colloidal ferric oxide was floated by sodium oleate, sodium benzoate, and "Gardinol." The nature of the film coating the ferric oxide particles was determined by the structure of the negative ion of the reagent used.

The reagent acted as both a frother and a collector, and only in the case of "Gardinol" was an additional collector found to be of value.

The gas phase was found to be necessary for flotation.

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3. Sorum. *J. Am. Chem. Soc.*, *50*, 1263–67 (1928).
4. Taggart. *J. Phys. Chem.*, *36*, 130–53 (1931).
5. Welsh. *Eng. and Min. J.*, *133*, 529–33 (1932).

(*Continued from page 300.*)

survey, but extra services donated by the School staff are estimated to have doubled the investment. In addition are the contributed services of the Committee on Economic Research, as well as those of the advisory committee of association heads, and the time and advice contributed by other association heads, the combined value of which it is impossible to estimate. It is now up to the individual members of the industry to show whether they appreciate and desire this type of research. They can show it by ordering and reading the book and forcing it into a second or third edition.

Fundamental Properties of Textile Wastes. VI. Electrophoresis of Platinum and Gold Hydrosols

By JAMES E. MAGOFFIN * and H. TEMPLE HATCH †

A Textile Foundation Publication

Introduction

IN a previous paper [1] the importance of electrical charge or zeta potential of particles in colloidal suspension was discussed, and a suitable method for experimental determination of electrophoretic velocity, from which the zeta potential can be calculated, was described. Using this method we have determined the effect of variations in pH on the electrophoretic velocity and zeta potential of hydrosols of platinum and gold. . These sols were chosen as typical hydrophobic sols, and because of their ease of preparation. It is hoped that these sols will serve as a basis of comparison for substances found in textile mill wastes.

Experimental Procedure

Both sols were prepared by the Bredig arc method using alternating current of 110 volts, 60 cycles, with a lamp bank resistance of 650 watts in series with the electrodes. The electrodes were 14 gauge platinum and gold wire. Best results were obtained with the platinum when the arc was formed under water made slightly alkaline with sodium hydroxide, while with gold, pure distilled water gave the most satisfactory sols. The concentration of the sols was determined by evaporating an aliquot portion to dryness, and weighing. The sols used in making the electrophoretic measurements were diluted to a concentration of 0.01 grams metal per liter, the pH being adjusted by addition of hydrochloric acid or sodium hydroxide before final dilution. In all cases the pH was measured with the Beckmann pH meter, the readings being accurate to within 0.02 units of pH.

The migration velocity measurements were made with the aid of a Zeiss slit type ultra-microscope, with an automatic carbon arc lamp as the source of illumination. The observing microscope in this apparatus is equipped with a 15.6 mm. focal length objective, and a 15 mm. focal length eyepiece, in which is located a cross-ruled eyepiece micrometer scale. The sol to be investigated is placed in the cell, previously described,[1] and adjusted under the microscope so that the beam of light from the lamp falls on the particles in the axial layer of liquid in the cell. A suitable cell holder has been constructed with which to make this adjustment.

* Dr. Magoffin is a Senior Investigator, and † Mr. Hatch was a Junior Investigator, of the Textile Foundation, working under the direction of Dr. Frank K. Cameron at the University of North Carolina. Dr. Magoffin is in immediate charge of the laboratory research on the Fundamental Properties of Mill Wastes.

The actual measurements are made by observing the movement of individual particles under the influence of a known external electrical potential. This potential is large enough to keep the particles moving in a straight path, but with a small enough velocity to permit accurate observations. The time required for a particle to move across the field of the eyepiece micrometer is taken with a stop watch, and after each reading the current is reversed to prevent polarization at the electrodes. For each investigation, observations were made on fifty particles, the speed of each particle being calculated in cm/sec/volt/cm. The average of the 50 speeds was taken as the average speed of the particles in that particular sol. In each case the average error was calculated and was found to be always less than 5% and usually less than 2%.

The zeta potential of the particles was calculated by the use of the following expression:

$$Z = \frac{4\pi u\eta}{DH} \times 90{,}000$$

where Z is the zeta potential of the particle in volts
u is the migration velocity in cm/sec/volt/cm
η is the viscosity of the liquid medium
D is the dielectric constant of the liquid
H is the external potential drop, in this case one volt/cm.

The value of the zeta potential in absolute units is obtained by dividing the value in volts by 300.

Experimental Results

Platinum particles in colloidal suspension carry a negative charge and migrate toward the anode under the stress of an external electrical potential. The zeta potential and the migration velocity are dependent on the H^+ ion concentration in the system, varying inversely with it. The relation is illustrated by the data in Table I and the curve in Fig. 1.

TABLE I

Platinum Sol 25° C.

pH	u in cm/sec	Z in volts	Z in e.s.u.
4.21	0.50×10^{-4}	0.65×10^{-2}	2.16×10^{-5}
4.91	0.70	0.91	3.03
5.67	0.99	1.28	4.28
5.90	1.04	1.35	4.50
6.87	1.35	1.75	5.84
8.02	1.64	2.12	7.09
8.42	1.71	2.22	7.39
9.22	1.73	2.24	7.48
9.82	1.97	2.55	8.52
10.26	2.07	2.68	8.95
10.58	2.07	2.68	8.95
11.00	1.94	2.51	8.39
11.39	2.10	2.72	9.08
11.88	2.27	2.94	9.81

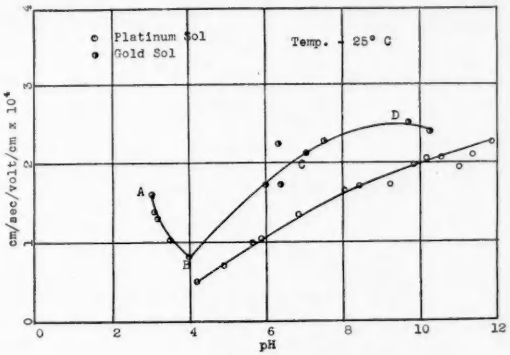

FIG. 1

Gold particles in colloidal suspension also carry a negative charge. Although the zeta potential and migration velocity are dependent on the H^+ ion concentration, the relation is not as simple as in the case of platinum sols. The data for gold are recorded in Table II and plotted in Fig. 1.

TABLE II

Gold Sol 25° C.

Sol No.	pH	Sign of charge	Velocity Cm/sec/volt/cm	Zeta potential volts	e.s.u.
1	7.05	−	2.11×10^{-4}	3.04×10^{-2}	9.12×10^{-5}
1	9.70	−	2.51	3.62	10.74
2	6.00	−	1.72	2.48	7.45
2	4.00	−	0.80	1.15	3.45
2	3.50	−	1.04	1.50	4.50
2	3.10	−	1.39	2.01	6.04
2	3.20	−	1.30	1.87	5.61
2	2.60	+ (?)	0.67 (?)	0.96 (?)	2.88 (?)
3	6.20	+	1.27	1.83	5.49
3	9.00	+	3.50	5.04	15.12
3	9.50	+	4.39	6.32	18.52
3	3.18	−	1.74	2.52	7.56
3	6.40	−	1.73	2.49	7.46
4	4.32	−	2.01 (?)	2.90 (?)	8.70 (?)
4	7.50	−	2.27	3.28	9.84
4	3.40	−	2.06 (?)	2.98 (?)	8.94 (?)
4	6.30	−	2.25	3.24	9.72
4	10.25	−	2.41	3.48	10.42
4	3.50	(±)	0.00	0.00	0.00

In one gold sol the particles were positively charged when first made. On standing, the zeta potential changed, until the particles were negatively charged, and had velocities falling on the curve in Fig. 1.

Discussion

Pennycuick [4] has shown that the behavior of colloidal platinum is best explained by assuming the particles to have this general composition:

$$xPt \cdot yPtO_2 \cdot z(Pt(OH)_6)^{=}2H^+.$$

When prepared by the arc method, the platinum is oxidized, in the high temperature of the arc, by oxygen, which results from the decomposition of the water by the arc. The negative charge of the particles is due to the ionization of the hexahydro platinic acid, the acid anion remaining fixed to the outer surface of the particles and the H^+ ions forming the outer or dispersed layer in the double layer system. Changes in the H^+ ion concentration in the system as a whole should affect the dissociation of the hexahydro platinic acid and thus the zeta potential of the particles. Increasing the pH or decreasing the H^+ ion concentration of the system will favor dissociation or dispersion of the H^+ ion layer, and the zeta potential will rise. Decreasing the pH or increasing the H^+ ion concentration will have the opposite effect. The above explanation is adequate for the curve in Fig. 1.

As with platinum, gold is oxidized at the temperature of the arc, and the particle will contain oxides and oxy-acids. Pauli [2] believes that the surface complex on the gold particles, when the arc is made in water or in alkali, is $(Au(OH)_2)^-H^+$. The complete picture of the particles will be given by this formula:

$$xAu \cdot yAu_2O \cdot z(Au(OH)_2)^-H^+$$

The negative charge of the gold particles is due to the ionization of the dihydro aurous acid, the acid anion remaining fixed to the outer surface of the particle and the H^+ ions forming the dispersed layer. The zeta potential, then, should be dependent on the H^+ ion concentration in the system. The curve plotted in Fig. 1 bears out this conclusion.

The gold system is more complicated than the platinum in that the curve for gold contains a transition point. This means that we are dealing with two ionogen complexes as compared to one for the platinum. Pauli [3] has shown that reversible anion exchange in the gold complex is quite readily accomplished, and probably follows these equations:

$$(Au(OH)_2)^-H^+ + HCl = (Au(OH)Cl)^-H^+ + H_2O$$
$$(Au(OH)Cl)^-H^+ + HCl = (Au(Cl)_2)^-H^+ + H_2O$$

The transition point in Fig. 1 can be interpreted as indicating the change from the pure hydroxy gold complex to the pure chloro gold complex, the mixed complex not being stable under the conditions encountered. Although chloro and chloro hydroxy platinum complexes can be prepared, the smooth curve for platinum indicates that they have not been formed in the sols studied.

As stated before, increasing H^+ ion concentration decreases the dissociation of the hydroxy gold complex, with a consequent lowering of the zeta potential of the particle. Increased H^+ ion concentration may have another effect on the complex; it may cause a decomposition according to the following equation:

$$(Au(OH)_2)^-H^+ = AuOH + H_2O$$

This will also tend to decrease the zeta potential. In the platinum system

this type of dissociation is probably not important because of the stability of the hydroxy platinum complex, but in the gold system it is important. From C to B in Fig. 1 this type of dissociation is undoubtedly involved in the drop in the zeta potential of the particles. The aurous hydroxide formed in the surface of the particles is converted into chloro complexes by the addition of more hydrochloric acid, and the zeta potential again rises as indicated by the portion of the curve BA.

The increase in zeta potential from C to D is due to increased dissociation of the hydroxy gold complex. The leveling off of the curve at D and the subsequent drop are probably due to the exchange of Na^+ ions for H^+ ions in the outer layer of the double layer system. The Na^+ ions, being able to approach the anion complex more closely than the H^+ ions, cause the zeta potential to fall off.

These studies indicate that this method will prove useful in determining the properties and reactions of components of textile mill wastes.

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Science and Empiricism

New sources of cellulose mentioned by *Rayon & Silk News* are, in Mexico, certain cactus plants; in Roumania, reeds; in Germany, brewer's refuse.

* * *

Manniophyton Africain is a Belgian Congo plant, said to have an 85% cellulose content, and to produce a fibre when properly manipulated that may be suitable for mixing with linen.

* * *

World staple fibre production in 1937 is estimated by *Rayon Organon* at 622, 900,000 lbs., of which Germany is credited with 220,000,000 lbs., Japan with 174,800,000 lbs., and Italy with 156,400,000 lbs. This country's output was only 20,100,000 lbs.

* * *

Spun glass fabric may compete with cotton fabric as a road reinforcing material if patent No. 2,115,667 granted to Carleton Ellis, Montclair, N. J., proves practical. Cloth or criss-cross tape of spun glass is used as a binder for asphalt roads.

* * *

Sheep clothed in cotton duck coats or rugs after shearing are reported to yield longer, cleaner and tipless fleeces, and also better mutton. Sir Frederick McMaster, sheep rancher of Dalkeith, Australia, is credited by Paul Seydel in *Cotton*, with being the originator of this innovation.

(*Continued on page 336.*)

Resiliency and Density of Some Upholstery Plant Fibres: Investigations on*

By BRITTAIN B. ROBINSON †

Introduction

There is a scarcity of printed information in reference to the degree of difference in the resiliency and density of various plant fibres used as filling materials by upholsterers. The filling capacity of such materials is important because if two fibres are equally resilient and have similar characteristics in many other respects an upholsterer would be more interested in the one with a greater filling capacity if the price were the same per pound. In the present study major differences in the resiliency and filling capacity, as studied in a small experimental press, between different fibres were determined. Differences due to grades or to the method used in preparing an individual fibre to loosen it up or the method of shredding leaf fibres were not determined.

Method of Testing

A PRESS shown in Fig. 1 was designed especially for the present study. It was constructed 10 in. square on the inside and 40 in. high. Inside this press chamber a weighed plunger was raised and dropped at the rate of two compressions per minute. This was accomplished by a large motor driven wheel in the periphery of which was a steel pin (P, Fig. 1) projected out sufficiently far to operate a lever arm to raise and drop the plunger with each revolution of the wheel. A checking weight stopped the lever arm after the plunger in the press had struck and compressed the fibre. A pencil, fitted into a flat plate resting on top of the fibre, projected through the press wall in a narrow vertical opening. The pencil recorded the up and down movements of the fibre on graph paper which was attached to the outside of the press.

In beginning a test, the fibrous material to be tested was placed in the press until the amount was sufficient to support a 50 lb. weight includ-

* Technical paper No. 282, Department of Farm Crops, Oregon Agricultural Experiment Station. Experiments were conducted in cooperation with the Division of Cotton and Other Fiber Crops and Diseases, U. S. Department of Agriculture. The writer expresses his appreciation to Dr. J. I. Hardy, U. S. D. A., Bureau of Animal Industry, for reviewing the manuscript.

† Agronomist, Division of Cotton and Other Fiber Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

ing the plunger itself, and until it occupied a space 18 in. deep in the press. If the weight compressed the fibre to a 17 in. depth the plunger was lifted by hand, the fibre fluffed up and additional fibre added to bring the total to the 18 in. depth when the plunger was again lowered slowly by hand. The inside of the plunger was then weighted with 40 additional pounds of lead making its total weight 90 lbs. The new height to which the fibre was compressed was then recorded and the motor-driven plunger started. The pencil recorded only the 2d, 3d, 10th, 20th, 50th, 100th, and 150th compressions. The 2d, 3d, 10th, and 20th were recorded on the graph in order to correct the height of the drop of the plunger if a certain fibre did not compress as fast or compressed faster than a fibre selected as a standard. The weight was dropped on each kind of fibre from similar heights for comparison purposes. This was accomplished by simply shortening or lengthening by one link or more the chain which was attached to the plunger. A correction made on the 3d or 10th compression was usually sufficient and no further correction was necessary.

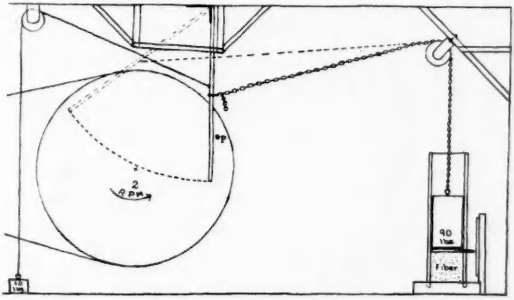

FIG. 1. Cross-sectional diagram of the experimental press used in determining the resiliency and filling capacity of the various plant fibres.

Preliminary tests indicated that the compressions should not be more than two per minute. It was found that it required about 7 to 9 seconds for the fibre to rise with its own resiliency. As the plunger was lifted the compressed fibre rose nearly instantaneously with the plunger approximately four-fifths of the total rise. The remaining one-fifth of the rise was a slow gradual rise after the plunger was off the fibre and took about 4 to 5 seconds. It is possible that a very small additional rise might have occurred if the compressions had been slower but it would hardly have been sufficient in most cases to record.

The machine was stopped after the 150th compression and the fibre removed and weighed in order to learn the filling capacity. A small sample of the fibre was taken for a moisture determination as the tests were conducted first during the spring months in Oregon when the humidity was very high and second during the summer months in Oregon when the humidity was very low.

Resiliency and Density Defined

In practice, fibre is judged for resiliency by the rapidity with which it regains its original shape when it is pressed in the palm of one's hand and then released. With experience, differences may be determined by such a method although the degree of difference may be unknown.

Schiefer [1] devised a machine for measuring the thickness of a textile or similar material when it was subjected to increasing or decreasing pressure. His machine was able to measure the compressional resiliency of a material by a gradual increase or release of pressure.

Hardy [2] developed an apparatus for compressing wool in order to determine the unit weight per volume or density of different samples of wool.

Dockstader [3] mentions an apparatus designed at the Massachusetts Institute of Technology in 1929 by Peterson and Wennberg for studying the resilient properties and further describes a new automatic machine but includes no results from tests.

Winson [4] prepared a laboratory apparatus for measuring the resiliency of wool by compressing the fibre gradually in a small rubber balloon. Schiefer and Winson apparently did not use sufficient pressure repeatedly on the same material to obtain a packing as occurs with a plant fibre when used as a stuffing in a cushion and subjected to repeated compressions. It is believed that such a compression is due more to an overloaded pounding, and an attempt has been made in this article to measure the resiliency under such compressions. It is realized that the method of testing used had some error due to friction of the fibre on the sides of the press but it was considered approximately equal for each plant fibre.

The term resiliency of a plant fibre material, as used in this article, is measured after 150 compressions of nine-tenths of a pound per square inch when the weight or plunger was dropped approximately 18 in. The upward movement of the fibre when the compression is released will be designated as positive resiliency. When the weight is dropped the material is compressed below the height where it later comes to rest. This compression, which is entirely below the positive resiliency, will be designated as negative resiliency. The positive and negative resiliency movements together are understood as the total or simple resiliency of the fibre.

In the trade, filling capacity is usually considered the amount of material required to fill a certain area before compression. Due to the fact that certain fibres tend to pack more readily than others, the filling capacity is given also for the amount of fibre required to occupy 100 cubic inches after 150 compressions of nine-tenths of a pound per square inch from a height of approximately 18 in. The height is determined while the fibre is supporting the weight at rest.

Discussion of Results

Resiliency of Plant Fibres.—Table I shows the resiliency (positive and negative) of a number of plant fibres which after compression represent different thicknesses of fibrous materials, as well as different weights of material which will be discussed later under filling capacity. The fibres ranked from the greatest total resiliency to the least total resiliency are as follows: southern moss, cotton linter pads, kapok, crin vegetal, raw cotton,

bulk sisal combings, flax upholstery tow and coir fibre. The maximum difference in resiliency between the fibre with the greatest and the least resiliency is 1.7 in. This represents a 78% greater resiliency in moss than in coir.

TABLE 1

Results obtained with different plant fibres when tested for resiliency and filling capacity under moist conditions

Name of fibre	No. tests	Moisture % dry basis	Fibre height after 10, 50, 100, 150 compressions in.				Resiliency after 10, 50, 100, 150 compressions in.				Fibre used grams	Filling capacity 100 cu. in. grams	Resiliency divided by height %
Moss	5	12.35	8.1	7.1	6.8	6.8	5.3	4.5	4.1	3.9	1930	283.8	57.3
Linters pads	5	7.43	10.2	9.7	9.4	9.2	4.3	4.1	3.9	3.8	1812	196.9	41.3
Kapok	5	10.75	11.7	10.7	10.5	10.5	4.0	3.7	3.7	3.7	1275	123.8	35.9
Crin vegetal	5	11.86	7.7	7.0	6.8	6.6	4.0	3.6	3.2	3.2	1934	293.0	48.5
Cotton	3	10.30	10.8	9.9	9.6	9.3	3.8	3.4	3.1	3.1	1963	210.4	32.7
Sisal	5	11.34	7.6	6.8	6.6	6.5	3.7	3.0	2.8	2.6	1633	251.2	40.0
Flax tow	5	12.62	7.3	6.5	6.3	6.2	3.1	2.7	2.5	2.4	2377	383.4	38.7
Coir	5	14.14	7.2	6.0	5.7	5.6	3.4	2.7	2.3	2.2	1452	259.3	39.3

It is interesting to observe that various plant fibres respond very differently to compression. The positive resiliency with some plant fibres is approximately equal to the negative resiliency, while in other fibres, such as cotton, the positive resiliency before repeated compressions is two or three times greater than the negative resiliency.

It is not known if the ranking of the plant fibres as given in a preceding paragraph is the correct interpretation of resiliency, due to the fact that different thicknesses of material were obtained after 150 compressions even though the thicknesses were the same at the beginning. Further, the weights of the materials used were different.

If the total resiliency is divided by the thickness of the material after 150 compressions an entirely different ranking of resiliency may be obtained which is as follows: southern moss, crin vegetal, linter pads, sisal combings, coir, flax tow, kapok, and raw cotton. This would indicate that the resiliency of the cotton and kapok is small when it is considered in relation to the thickness of the padding. Therefore, it is believed that the first ranking of the plant fibres for resiliency is the method understood in the trade. It is interesting to observe that southern moss ranks high in resiliency by either method of ranking but has a poor filling capacity after compression.

Filling Capacity of Plant Fibres.—As fibrous raw material is bought by weight, the filling capacity of the fibre is important as well as the resiliency. Due to the fact that the filling capacity varies as well as the resiliency the upholsterer's problem of proper selection of a material to use is difficult. This is further complicated by the price variations of the different fibres.

Table 1 shows the ranking order of the filling capacity of the different plant fibres when the height after 150 compressions is divided by the amount of plant fibre used. The rank of the plant fibres is as follows: kapok, cotton linter pads, raw cotton, sisal combings, coir, crin

vegetal, southern moss, and flax tow. It requires more than three times the weight of flax tow to fill the same area as it does kapok. The filling capacity of the fibres has materially changed as a result of the compressions. The change has not been as great with kapok, cotton linters and cotton as it has been with flax tow, crin vegetal, sisal, moss, and coir. In other words, kapok and cotton do not pack down after repeated compressions as subjected to in these tests as much as the other fibres.

It is generally understood that the resiliency is greater in dry weather than in moist. In some mills where the raw fibre is being baled it is known that the damp humid weather changes the filling capacity, and the bales for shipment are much heavier if prepared in a humid weather than those prepared in a dry period if equal pressure is applied.

Table 2 shows results obtained under drier conditions than the ones presented in Table 1. The method of testing was similar. It will be noticed by comparing Tables 1 and 2 that the resiliency under dry conditions is greater than under damp conditions even with less material. In other words, in dry weather the filling capacity of a material is increased as well as its resiliency. Although it is possible that temperature may have affected the results somewhat, because it may have varied as much as 15° F. during the tests, it is believed that its main effect was to increase the water absorbing power of the air and in this way act indirectly. This would indicate that in the dry periods of the year or in a dry section of the country greater force should be used in packing a stuffing than in moist weather. The ranking of the different fibres for resiliency and filling capacity was not greatly affected by the difference in the moisture content of the fibre. The position of sisal combings was lowered in the ranking order for resiliency when tested under drier conditions, although sisal made into pads maintained its position above coir and flax tow. The small difference of 1 to 3% moisture present in a fibre resulted in marked differences in the resiliency and filling capacity of a fibre as shown between results presented in Tables 1 and 2. All the fibres were not tested the same day or week; so the moisture of the air may have varied. The results indicate, as previous workers have determined, that fibres vary in their affinity for moisture. Moss and coir may have a high affinity for moisture and cotton low in comparison.

Table 2

Results obtained with different plant fibres when tested for resiliency and filling capacity under dry conditions

Name of fibre	No. tests	Moisture % dry basis	Fibre height after 10, 50, 100, 150 compressions in.				Resiliency after 10, 50, 100, 150 compressions in.				Fibre used grams	Filling capacity 100 cu. in. grams	Resiliency divided by height %
Moss	5	11.29	7.7	6.8	6.5	6.4	5.4	4.5	4.3	4.2	1724	258.1	64.8
Linters pads	5	6.43	10.1	9.5	9.3	9.1	4.8	4.4	4.3	4.2	1754	192.1	45.7
Cotton	5	6.41	11.6	10.8	10.6	10.4	4.6	4.3	4.2	4.1	1868	179.6	39.4
Crin vegetal	5	8.99	7.7	7.0	6.8	6.7	4.8	4.3	4.1	4.0	1698	254.9	59.3
Sisal pads	5	7.93	10.3	9.5	9.2	9.0	4.4	4.0	3.8	3.7	2078	230.9	41.1
Flax tow	4	9.75	6.9	6.2	6.0	5.8	4.0	3.6	3.5	3.4	1877	323.6	58.6
Coir	5	10.34	7.3	6.2	5.8	5.7	3.8	3.0	2.7	2.5	1316	230.1	43.7
Sisal	5	8.19	6.1	5.3	5.1	5.0	3.2	2.6	2.3	2.2	1276	255.7	44.1

Resiliency Characteristics of Similar Compressed Thicknesses of Materials.—In the previous discussion, plant fibres have been compared in reference to resiliency and filling capacity when the fibres supported a similar weight at an 18 in. height before compressions began. It is interesting to compare the results which are obtained with the same fibres when, after 150 compressions, they are compressed to equal depths.

TABLE 3

Results obtained with approximately similar thicknesses after 150 compressions of plant fibres

Name of fibre	No. tests	Moisture % dry basis	Fibre height after 10, 50, 100, 150 compressions in.				Resiliency after 10, 50, 100, 150 compressions in.				Fibre used grams	Filling capacity 100 cu. in. grams	Resiliency divided by height %
Moss	1	11.07	11.7	10.8	10.5	10.3	6.8	6.0	5.7	5.3	2630	255.3	51.4
Crin vegetal	1	8.84	12.1	11.1	10.7	10.5	5.9	5.6	5.4	5.2	2590	246.7	49.5
Linters pads	1	6.09	11.2	10.7	10.4	10.3	5.4	5.1	4.9	4.9	1970	191.2	47.5
Cotton	5	6.41	11.6	10.8	10.6	10.4	4.6	4.3	4.2	4.1	1868	179.6	39.4
Sisal	1	7.41	13.2	11.4	10.8	10.6	4.5	3.3	3.1	3.0	2630	248.1	28.3
Coir	1	8.44	14.6	11.7	10.7	10.5		3.3	2.7	2.6	2430	231.4	24.8

Table 3 shows the results when such tests were performed. An attempt was made to have all of the fibres act similarly to cotton, each having approximately 10.4 in. of compressed fibre after 150 compressions. Some of the advantages cotton and kapok have had in Tables 1 and 2 due to their greater depth are overcome in this table and moss and crin vegetal show superior resiliency but poorer filling capacity after compression.

Other Factors Affecting Choice of Plant Fibre

It is believed by many upholsterers that the age and usage of the fibre affect the resiliency. Kapok is considered to have a relatively short period of usefulness lasting approximately 5 to 10 years in chairs or pillows which receive an average household service. Other plant materials such as moss have an extremely long life, and additional plant fibres vary one way or the other.

It is uncertain if all the plant fibres discussed in this article should be compared directly one with another. An upholsterer uses certain materials for one purpose and others for another purpose. Kapok and cotton may not be used in general for the same type of upholstering as crin vegetal, coir or flax tow.

Flax upholstery tow is prepared from different qualities of flax straw and by several different machines which probably affect the resiliency as well as the filling capacity. Results of comparative tests indicated that the flax tow with the least amount of wood present had a slightly greater resiliency, but its filling capacity was poorer than tow with more wood present. Differences in the preparation of plant fibres and the climatic conditions under which a fibre is grown have been reported to affect resiliency.

Conclusions

The resiliency and filling capacity of several plant fibres were determined in a small experimental press. The method of testing was believed to be more comparable with usages these fibres are subjected to in every day life than previous methods of testing.

Fibres ranked in order of their filling capacity after compressions are: kapok, linter pads, cotton, sisal combings, coir, crin vegetal, southern moss, and flax tow.

Fibres tested under humid conditions ranked in order of their resiliency when each with a depth of 18 in. supported a similar weight before compressions are: southern moss, linter pads, kapok, crin vegetal, cotton, sisal combings, flax upholstery tow, and coir.

Fibres ranked in order of their resiliency when each after 150 compressions supported a similar weight at approximately the same height, are: southern moss, crin vegetal, linter pads, cotton, sisal, and coir.

Drier fibre increases the resiliency and filling capacity of plant fibres.

Flax tow prepared nearly free of shives or wood has greater resiliency but less filling capacity than tow with much wood present.

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"The word research cannot be given any narrow interpretation. Research is very broad. It is not just test-tubes and wires, but rather an organized, systematic search for new knowledge, a search conducted along numerous interrelated paths." Thus states Dr. Vannevar Bush, vice-president, Massachusetts Institute of Technology, and president-elect of the Carnegie Institution of Washington, one of the world's greatest research organizations.

Some Production and Biological Aspects of Cotton Quality*

By H. W. BARRE†

THE coördinated cotton research program of the United States Department of Agriculture and the State Agricultural Experiment Stations has now been under way several years and while many of the researches are still in the early stages, some important results and implications have already come from these studies. Brief mention is made here of some of these.

It is interesting to note that the plan for a coördinated research program is working out very nicely. There are more Federal and State agencies and more private and commercial agencies working on cotton and cotton products than on any other crop or commodity, and yet we feel that the work being done by all of these agencies is being well coördinated. The Federal and State agencies are in fact working together on a joint program for more economic production of cotton of improved quality and for the more efficient and wider use of American cotton, and the private and commercial agencies are working effectively with the public agencies to these same ends.

Reference has been made in earlier papers to the Regional Variety Study which involves the planting of 16 varieties or types of cotton from the same seed stock at 14 different places across the cotton belt and seven varieties at four locations in the irrigated sections of the southwest for three years in succession in order to study the influence of variety, soil, climate and season on fibre properties and spinning value. While the fibre analyses and spinning results from these studies have not been completed and only preliminary results from the first year's crop are available, some of these are interesting and apparently important from the standpoint of improving the quality of our cotton.

Factors Determining Quality

The indication so far (the effect of season on fibre properties has not yet been studied) is that the variety seems to be the most important single factor in determining quality. In the case of staple length, variety is very definitely the most important factor. Contrary to popular opinion, there is seldom more than 1/8 in. difference in the staple length of any particular variety when grown in the southeast or in the Mississippi Delta under optimum moisture conditions, or when grown under the extremely dry conditions

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of 1935 in Oklahoma and west Texas. The combined average staple length of these 16 varieties in 1935 varied only from 1/16 to 1/8 in. under these widely different conditions. It was somewhat surprising to find that the longest average staple length of these varieties at any point in the cotton belt in 1935 was obtained from the test located near Greenville, Texas. The shortest staple for this season was produced at Stillwater, Oklahoma, where there was almost a complete crop failure because of extremely dry weather. These findings tend to confirm the belief that inheritance and soil moisture are the two main factors in determining staple and of these inheritance is the more important. This demonstrates, fairly conclusively, that the only practical way to improve the staple length of cotton is to plant varieties that are known to produce longer staple.

Fibre Fineness an Inherited Quality

Fineness of fibre as determined by weight per unit length appears to be inherited just as definitely as staple length. These 16 varieties grown across the belt show the same relative fineness at all of the places where they were grown, and in most cases about the same actual fineness. In this connection the cross-section method of studying fineness and shape of fibres now being developed by Dr. Karrer and Mr. Bailey of the Bureau of Agricultural Economics, is of interest to students of genetics and those engaged in cotton breeding and in adapting cotton possessing different fibre properties to special uses. Since fineness seems to contribute materially to spinning value, we have placed considerable emphasis on this property in our genetics research. The very fine Hopi cotton, which Dr. Kearney of the Bureau of Plant Industry called attention to several years ago, and which Dr. Webb and his associates in the Cotton Marketing Division of the Bureau of Agricultural Economics have studied, is being used as one of the parents in many of our crosses. The preliminary work along this line indicates that fineness is inherited in a definite way. There are, however, some indications that the growth conditions obtained at the different locations affect fineness to some extent. This question is being carefully checked from the large amount of material available from the Regional Variety Study and from certain physiological investigations under way at different places.

Fibre Strength and Yarn Strength

Studies of strength of the fibres by the Chandler bundle method show that there is a very wide difference in the average strength of these varieties at the different locations. The varieties in most cases, however, rank in the same relative order, some varieties producing stronger fibre than other varieties at all locations. The strength as determined by this method is closely correlated with the spinning value as indicated by yarn strength, and some of the preliminary results from the spinning tests of these varieties at the spinning laboratories of the Bureau of Agricultural Economics throw more light on this question. Mr. M. E. Campbell, in charge of all of their cotton spinning research, and Mr. R. L. Lee, in charge of the spinning work at College Station, Texas, have summarized some of the preliminary results secured from spinning seven of these varieties of the 1935 crop at eight of the locations in a paper which they prepared for a recent conference at College Station, Texas. While these results (to be published

later) cover only seven of the varieties included in the study and only eight of the locations for 1935, the preliminary findings are of considerable interest. These results indicate that the location at which the cotton is grown and the seasonal conditions under which it is produced affect the strength of the yarn. Since this work represents only one crop, we do not know, of course, how much of the effect is due to seasonal conditions and how much might be due to location, but when we average the yarn strength for the seven varieties at each of these places we find that for this particular season the cotton from Arkansas and east Texas produced a stronger yarn than the cotton from Louisiana and South Carolina. With the exception of the Delta region of Mississippi, the locations which produced the weakest yarn were the ones where the largest yields were obtained, and the cotton which produced the strongest yarn came from the locations where the yield was less.

The influence of variety on yarn strength was more pronounced and since these eight locations were widely separated over the cotton belt extending from Florence, S. C., to Lubbock, Texas, and different seasonal conditions obtained at the various places, the results are probably a little more significant. The seven varieties included in these spinning tests are ranked in the following order in terms of yarn strength; Acala, Rowden, Dixie Triumph, Startex, Oklahoma Triumph, Qualla, and Half and Half. It is interesting to note that with a few exceptions these varieties ranked in approximately the same order at all of the locations. The most striking exception was in the case of Dixie Triumph which averaged third from all locations but ranked second at one and sixth at two places, and Qualla which ranked sixth at all of the places except two and in these cases ranked third. Half and Half, which is the shortest and coarsest of all of the varieties, ranked at the bottom in each case, and Acala which is the longest and finest ranked first at all of the locations but one where it ranked second. In the main, the cottons which gave the highest yarn strength were those possessing the finest fibre and longest fibre, as well as the greatest strength as indicated by the Chandler bundle method. Thus, the variety of cotton planted seems to determine in a large measure the strength of the fibre and the strength of the yarn.

An Example of Seasonal Variation

We must not overlook, however, the possiblities of seasonal variations in cotton quality, of which we have heard so much in recent months. It is now well known that the mills of this and other countries have noted a marked decrease in the spinning quality of the cotton from the 1937 crop. In connection with our Regional Variety Studies, we were very fortunate in having one of our three test years coincide with this unusual crop. When the reports of the poor quality began to come in, we had not had an opportunity, of course, of making any studies of this material. However, we were anxious to see what our samples would tell us, and a study was started early this spring to compare material representing two different varieties produced in 11 locations across the Belt for both the 1936 and the 1937 seasons.

Preliminary data from these spinning tests reveal some interesting facts, and work is being pushed on the physical, chemical and X-ray investigations to determine what fibre properties have been affected and the extent to which they have been altered. Then, by making detailed analyses

of the weather data at each of the stations for the two crop years, it is hoped that an explanation for the seasonal differences can be found.

Briefly, the preliminary results for this special study show the folfolowing facts: (1) The average skein strength for the two varieties grown at the 11 locations was 8% lower in 1937 than in 1936. (2) One of the varieties was more seriously affected than the other. (3) Decrease in yarn strength amounted to as much as 36% at a single location. (4) In some locations, there was no deterioration in yarn strength whatever in a comparison of the 1937 crop with that of 1936.

Cotton to Meet Any Mill Demand

The fact that the kind of seed planted seems to determine to a considerable extent the length, fineness, strength and other properties of the fibre produced is extremely important from the standpoint of the improvement of the quality of American cotton as well as from the standpoint of the production of cottons possessing special fibre properties required for special uses. It is realized, of course, that cotton of special character is required for many of the uses to which cotton is put. A long, fine fibre, for example, is needed for making thread, certain kinds of fine goods and fabrics where strength is the prime consideration, and coarse, medium length, or short fibres are used for cotton and wool mixtures and for certain coarse goods. Each manufacturer has his own requirements, at least his own idea as to the special fibre properties required for his purposes. Since each of the major fibre properties is inherited, we are encouraged to believe that we can bring these fibre properties togther in almost any combination that the manufacturer requires. In fact, there are in the Bureau's genetic materials and breeding blocks, already, almost all imaginable staple lengths and degrees of fineness and coarseness that might be required.

The big problem at present is to determine just what the mill requirements and use values are. In 1937 there was imported into this country, 253,034 bales of cotton. In other words, the United States, the greatest cotton-producing country in the world, sent out of the country between fifteen and twenty million dollars for cotton produced in other parts of the world. It may be assumed that the explanation for this is that the manufacturers believe that the cottons they are importing serve their purposes better than anything that is grown in this country. The point which it is wished to make is that if it can be found out what it is the manufacturers need for the various types of goods they make, and if their coöperation can be obtained in developing the kinds of cotton they require, it is believed that this country can produce cotton possessing any character or combination of properties that can be produced any place else in the world.

One-Variety Communities

In this connection brief mention should be made of the progress that is being made in standardized production of superior types of cotton in one-variety communities. With superior varieties of inch cotton as a basis, the Bureau of Plant Industry is coöperating with the Extension Service and Experiment Stations in the several States in standardizing production according to the one-variety community plan. Under this plan only one variety of cotton is planted in the community, the gin community usually

being the unit, so that all of the cotton that goes to the gin is of the same variety and there is no chance for mixing the lint or seed of one variety with that of another. In this way large even-running lots of superior cotton are available to the trade in each of these communities, the production in individual communities sometimes amounting to as much as five or ten thousand bales.

Some manufacturers are now seeking one-variety cotton and are going back year after year to buy their supply from the same community. This method of standarized production has expanded quite rapidly during the last three years and there are now 814 communities in 343 counties in 14 cotton-growing States all the way across the country from North Carolina to California, and in 1937 there were approximately 2,000,000 bales of cotton produced in one-variety communities. With more than 10% of the entire acreage now grown in one-variety communities, it is possible to increase standardized production much more rapidly than could have been done earlier because there should be enough pure seed produced in one-variety communities this year to plant a large part of the American acreage of cotton in 1939.

Besides serving to produce large even-running lots of cotton of uniform quality, this type of organization will permit rapid change to better varieties selected on the basis of fibre, spinning and other data, or to different types that the trade might demand. By bringing the seed of the new variety into the community and growing it on several key farms one year, it can be increased to a larger acreage the second year and at the end of the third year the whole community, or in cases where the whole county is organized into communities, the entire county could be changed to the new variety without its interfering with or becoming mixed with the old variety.

As varieties or strains are developed that are adapted to special uses, these can be increased and brought into large-scale production on this basis. This method has been used for a number of years in the areas producing American Egyptian cotton and is now being adapted to the organized production of Sea Island in Florida and Georgia. In other words, this type of organization for standardized production seems well adapted to all types of cotton and to a wide variety of conditions.

Another point of interest in this connection is the fact that Congress enacted a law last year providing for a free grade and staple service to communities that are organized for the purpose of improving the quality of their cotton. This will mean that the growers of superior quality cotton will be furnished free by the Department of Agriculture the grade and staple of their cotton together with market news information indicating the market value from day to day of the different grades and staple lengths. Heretofore the biggest handicap to cotton improvement has been the system of hog-round buying on the local market.

Basic Research on Fibre Growth

Over a period of ten years or longer, the Department has presented to the textile interests from time to time information derived from researches on the growth and structure of cotton fibre. In order to bring you up to date on this subject, reference is made to some of the results of studies made during the past two years by Doctors Anderson and Kerr of the staff of the

Bureau of Plant Industry, coöperating with the North Carolina Experiment Station at Raleigh. The preliminary results of these studies were published in the *Journal of Industrial and Engineering Chemistry*.[1] These results have been presented in the *Journal of Agricultural Research*[2] by Dr. A. G. Lang, who was formerly associated with these workers.

Anderson and Kerr's studies indicate that all of the fibres which develop into lint cotton arise from the epidermal layer of the seed coat within two or three or four days after the square blooms. The fuzz fibres develop later. These begin to form about the sixth or seventh day after flowering and continue through the tenth or eleventh day. With some of our naked seed varieties where there is no fuzz, the fibre growth pattern is completed in the course of three or four days. We know, of course, that some varieties of cotton produce lint of more uniform staple length than other varieties. It would appear in the light of these recent findings that the many different fibre lengths which occur in a given sample and the wide range in the length of different fibres on the same seed are due quite largely to a difference in the rate of growth of these individual fibres, rather than to the difference in the number of days that the fibres have for elongating. It appears that the fibre and fuzz cells continue to elongate until the boll has reached full size, which, in mid summer in case of upland varieties, is about 16 or 18 days after blooming. At this time elongation stops and secondary thickening begins. This is an interesting and important point from the standpoint of cotton breeding and production.

The detailed study of the structure of the cell wall of the fibres has contributed much to our knowledge of cotton fibres. For the first time we have a picture of the detailed structure of the primary cell wall as it exists for the first 16 or 18 days after blooming and of the wall of the cells and the fibres, as they continue to thicken during the balance of the time until the boll is almost ready to open. Secondary thickening is completed in most cases four or five days before the bolls open. This is probably the reason why there are so many thin walled fibres in cotton that opens prematurely.

Daily growth rings, indicating the amount of cellulose deposited each day during this period of thickening, can be observed in properly treated cross-sections of the fibres. Structure of these daily growth rings has been worked out and it has been found that temperature and sunlight affect the rate at which the cellulose is deposited and, therefore, determine the thickness of these daily rings. Cotton is now being grown under controlled conditions of temperature, moisture and light, in an effort to gain additional information as to just how these different physical factors influence the structure of the fibre.

These fundamental studies then provide a basis for further research in genetics and physiology and give us a starting point for determining to what extent specific fibre properties are inherited and to what extent they are influenced by other biological and physical factors.

References

1. "The Growth and Structure of the Cotton Fibre," by Donald B. Anderson and Thomas Kerr. *Ind. Eng. Chem.*, Jan. 1938, P. 48–54.

2. "The Origin of Lint and Fuzz Hairs of Cotton," by A. G. Lang. *Jour. Agr. Rsch.*, V. 56, No. 7, Apr. 1, 1938, P. 507–21.

Abstracts

Committee on Abstracts and Bibliography:
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Address, C. H. Clark, Sec., 65 Franklin St., Boston, Mass.

I. Fibres (Synthetic and Natural) and Fibre Analysis

Acid Dyeing of Wool: Contributions to the Theory of. No. VIII. The Effect of Hydrogen Ion Concentration and Levelling Agents on the Dyeing Behavior of the Palatine Fast Dyes. W. Ender and A. Müller. *Mell. Textilber.*, 1938, No. 3, P. 272.

The authors have investigated the influence of hydrogen ion concentration on the dyeing behavior of the Palatine Fast dyes and found that the capability of the coloration of wool by the Palatine Fast dyes reaches its maximum at a definite pH range, which is higher for Palatine Fast monosulphonic acids than in the case of the disulphonic acids. The levelling effect of mineral acids and of Palatine Fast Salt O in the dyeing of Palatine Fast colors is attributed to a lowering of the affinity owing to hindering of the formation of the complex compound between the chromium complex of the dyestuff and the basic groups of the wool. In the case of mineral acids, the cause of the diminished inclination to form the wool-dyestuff complex is the greater ionization of the basic groups of wool, and in the case of Palatine Fast Salt O the attachment of that compound to the dyestuff molecule. In many instances, especially in the case of Palatine Fast disulphonic acids, mineral acid or Palatine Fast Salt O increases the speed of absorption of the dyestuff. (C)

CASEIN WOOL. *Dairy Ind.*, 1937, V. 2, P. 289–91 (through *Brit. Chem. Abs. B*, 1937, V. 56, P. 1032); abs. in *J. T. I.*, Jan. 1938, P. A6.

The latest improvements consist in pretreating the lactic casein with a solution of silicon sulphide before making the filaments, modifying the coagulating medium, and accentuating the wool-like character of the fibre by chlorination. Values of some physical properties of natural and casein wools are compared. (C)

FERMENTATIVE DEGUMMING OF WASTE SILK. I. EFFECT OF FERMENTATIVE TREATMENT UPON THE DEGUMMING OF SILK AND THE PRELIMINARY SELECTION OF THE USEFUL DEGUMMING BACTERIA. II. BACTERIA ISOLATED FROM DEGUMMING LIQUIDS OF WASTE SILK. III. CHARACTERISTICS OF THE USEFUL DEGUMMING BACTERIA. H. Katagiri and T. Nakahama. *J. Agr. Chem. Soc. Japan*, 1937, V. 13, P. 1003–22; abs. in *C. A.*, 1938, V. 32, Col. 1103. (W)

FIBRES: COMPETITION IN. Anon. *Am. Wool & Cotton Rptr.*, 1938, April 21, P. 7–8, 27; April 28, P. 17–18, 32–3.

Discusses progress in quality and characteristics of rayon yarn; its relation to silk and wool; fabric requirements and characteristics, and cut fibre possibilities. (C)

FIBRES: SURFACE STRUCTURE. H. Margaretha and H. Mark. *Mell. Textilber.*, 1937, V. 18, P. 817–22; abs. in *J. T. I.*, Jan. 1938, P. A38.

The important influence of surface structure on the properties of textile fibres is discussed with special reference to the dyeing of cellulose fibres with substantive dyes, and a survey is made of the present state of knowledge of the structure of cellulose fibres as revealed by microscopic studies in visible, ultra-violet and polarized light and by the application of X-ray and cathode-ray methods. It is pointed out that fibres with a well-defined micellar structure with comparatively large spaces between the micelles and with fissured surfaces have mild lustre, swell strongly, dye easily, but are not fast to rubbing, and generally, owing to low degree of orientation, have low strength but high extensibility and resistance to creasing. Fibres of pure chain structure have a hard glassy or metallic lustre, swell little, dye poorly with substantive dyes and have high strength but low extensibility and resistance to creasing. For practical purposes something between these two extremes is generally required. (C)

RAYON: INCREASING THE ELASTICITY OF. H. Roche. *Silk J.*, 1937, V. 14, No. 161, P. 26; abs. in *C. A.*, 1938, V. 32, Col. 786.

The progress of processes using latex-casein-glue combinations or proteins such as dissolved hair, silk and wool in NaOH for a bonding material between rubber and rayon is discussed. (W)

SOLUBILITY OF STAPLE RAYON IN CAUSTIC SODA LYE. H. Christoph. *Kunstseide u. Zellwolle*, 1937, V. 19, P. 295–8; abs. in *C. A.*, 1938, V. 32, Col. 1103.

In earlier investigations of staple rayon in which only strength tests and indirect detns. of soly. were carried out, it was overlooked that dissolved and repptd. cellulosic material agglutinates and so acts as a finishing

agent through which the strength test and the soly. detn. become questionable. The danger point at which staple rayon from viscose is attacked at 20° is not limited to a concn. of 15 to 22° Bé. Nor is the max. soly. at a concn. of 15 to 16° Bé. A NaOH soln. of 9% by wt. (approx. 13° Bé.) gives a max. swelling and soly., but this is not quantitatively the same with each staple rayon. The stretching process and the kind of cellulose from which the rayon is made affect the soly. A sample of stretched silk compared with an unstretched but otherwise identical one inclines to lower absorption of moisture. (W)

(New) Staple Rayons and Their Cross-sectional Pictures. III. Paul-August Koch. *Klepzig's Textil-Z.*, 1937, V. 40, P. 728; abs. in *C. A.*, V. 31, Col. 4822; V. 32, Col. 1447.

Cross-sectional pictures are shown for Feinflox 38, E–T, 1.0 den.; Glauchau ZW, E–T, 1.5 den.; Floxalan 66/37, E–T, 3.75 den.; Phrix BR, E–T, 1.5 den.; Phrix KN, E–T about 4 den.; and Phrix TW, E–T, 18 den. (W)

Textile Industry and Modern Chemistry. G. Point and J. L. Jortay. *Teintex*, 1937. V. 2, P. 431–4; abs. in *C. A.*, 1938, V. 32, Col. 785.

Theoretical principles of the strength of cotton fibres, a critique of the math. relation of Hartig expressing these principles, the proposition of a new theory and its application to cellulose. (W)

Viscose Rayon and Staple Rayon: Progress in Manufacture of. Hans O. Koecke. *Spinner u. Weber*, V. 55, No. 44, P. 24; *Deut. Textilwirt.*, V. 4, No. 20, P. 5–6 (1937); abs. in *C. A.*, 1938, V. 32, Col. 769, 1447. (W)

II. Yarns and Fabrics

Automatic Machines for Pirn Winding and for Warp Tying. Muschamp Taylor, Ltd. *Tex. Mfr.*, March 1938, P. 110.

A further improvement has been made on the Hacoba automatic pirn winder. A new warp tying machine is entirely mechanical and relatively inexpensive. (C)

Baldus-Pross System of Cotton Spinning. *Tex. Mfr.*, March 1938, P. 113.

Drawing frames have trumpets, with spring-controlled jaws and very small orifices, set close to the nip of the calender rolls of the coiler. The drawing frame sliver is fed directly to a single-process speeder, and the roving to a high-draft ring frame. Many German mills running on a wide range of cotton, rayon staple and cottonized bast fibres in a variety of mixtures for counts from 6s to 42s are using this process. (C)

Bast Fibre Machinery: Simplified Working Calculations for. J. Barbour Pears. *Tex. Mfr.*, 1938, March, P. 96–7; April, P. 142–4, 154.

Balancing output from different processes and machines for flax, jute, hemp, and hard fibres, and factors to be taken into account. (C)

COLOR AND ITS APPLICATION IN WOOLEN AND WORSTED CLOTHS. S. Brierley. *Tex. Mfr.*, 1938, March, P. 104–5; April, P. 152–3.

A systematic method of securing every possible color effect with any particular weave and coloring. (C)

CREASE-RESISTING FINISHES. C. L. Wall. *Tex. Mfr.*, April 1938, P. 164.

An explanation of the elasticity involved in crease resistance, in generalized terms applying to the molecular structure of fibres. A technical discussion of the methylol urea resin anti-crease process is given, with some suggestions having special reference to rayon. (C)

FABRICS: SHRINKING. K. Heinrich. *Kunstseide*, 1937, V. 19, P. 338–42, 360–5; abs. in *J. T. I.*, Jan. 1938, P. A40.

The author discusses the shrinkage of textile fabrics, especially those made of wool, cotton, rayon and staple fibre, shows how it is dependent on fibre, yarn and fabric structures and on the tensions to which the yarns have been subjected in preparatory and weaving processes, and outlines methods by which the tendency to shrink may be reduced. (C)

FINISHING OF MODERN ALL-SPUN RAYON FABRICS. Bernard S. Hillman. *Rayon Tex. Mo.*, Feb. 1938, P. 65–6. (C)

FIREPROOFED FABRICS: TESTING. G. Durst. *Mell. Textilber.*, 1937, V. 18, P. 824; abs. in *J. T. I.*, Jan. 1938, P. A41.

Tests based on observations of the burning of strips of fabric, as used by Clarence and by Kline, are described and standard conditions for these tests are outlined. Typical results are briefly discussed and the influence of moisture content is mentioned. A method of testing liability to ignition by flying sparks is also described. (C)

HEAT RESISTANT CORD. Russell B. Newton. *Am. Wool & Cotton Rptr.*, Feb. 10, 1938, P. 45, 47, 49, 51; *Cotton*, Feb. 1938, P. 114.

Description of new patented process developed by Bibb Mfg. Co., characteristics and advantages of new cord. (C)

ORGANIC FAT SOLVENTS IN TEXTILE (COTTON) FINISHING AND CLEANING PROCESSES. Leo Kollmann. *Mell. Textilber.*, 1938, No. 3, P. 269. (C)

PHYSICAL PROPERTIES OF KNITTED SILK STOCKING FABRICS. W. Davis. *J. T. I.*, Feb. 1938, P. T18–T22.

This work is in sequence with two previous papers on fabric properties and is concerned with the measurement of the bursting, tensile and wearing strengths of fabrics and their relation to yarn strengths. (C)

PULVERIZED FIBRES: MANUFACTURE AND USES OF. D. Martin. *Dyer*, 1937, V. 78, P. 321–3, 371–72; abs. in *J. T. I.*, Jan. 1938, P. A29.

Methods are described for pulverizing cotton, wool, rayon and silk rags and waste, for dyeing the powders and for applying them to various surfaces in accordance with the use for which they are intended. (C)

RAYON CUSHION COVERS: DAMAGE BY MOTHS. A. Hase. *Mell. Textilber.*, 1937, V. 18, P. 765–71; abs. in *J. T. I.*, Jan. 1938, P. A42.

Statements concerning the attack of rayon by moths made by various writers are quoted and discussed and the author expresses agreement with the view that rayon cannot serve as food for the larvae, but when mixed intimately with wool or other food it may be eaten but is not digested by the larvae, and that rayon may be damaged by having cocoons attached to it or by being bitten into fragments for use in the construction of cocoons. (C)

RAYON STAPLE FIBRES: HISTORICAL DEVELOPMENT AND PATENTS OF. Edward C. Worden, 2nd. *Rayon Tex. Mo.*, 1938, Feb., P. 41–4; Mar., P. 39–40; April, P. 70–1; May, P. 39–41.

A series of four articles on the historical development and the patent situation of all rayon staple fibres. (C)

RAYON STAPLE: PROCESSING OF—ON COTTON EQUIPMENT. Arthur E. Oxley. *Rayon Tex. Mo.*, 1938, Feb., P. 49–52; Mar., P. 53–4. (C)

RAYON STAPLE: PROCESSING OF—ON WOOLEN EQUIPMENT. Robert A. C. Scott. *Rayon Tex. Mo.*, Feb. 1938, P. 53–6. (C)

STAPLE FIBRES: DETERMINING AVERAGE DENIER OF—IN MIXED AND SELF FABRICS. Werner von Bergen. *Rayon Tex. Mo.*, Feb. 1938, P. 56–9.

Describes extensive tests made on acetate and viscose staple fibres to ascertain whether or not the methods for wool fineness apply and to what extent they can be used in determining the selection of staple fibres in mixtures with given grades of wools. Results lead to the conclusion that the methods for establishing the fineness of wool are well suited for the determination of the average filament size of rayon staple fibres in semi-manufactured materials as well as finished fabrics, either in self or mixture condition. With the aid of an established width measurement curve, one can readily determine the equivalent denier size of fibres based on the average microns found. (C)

TEMPERATURES IN DRYING. B. R. Andrews. *Am. Dye. Rptr.*, March 21, 1938, P. 141–4; *Mech. Engr.*, March 1938; *Tex. Resch.*, May 1938, P. 231–6.

Their effect on cost of operation and wear resistance of textiles. A paper presented at meeting of Textile Division, Boston, Mass., Oct. 15, 1937, of A. S. M. E. (C)

TEXTILE PRINTING FORMS: PREPARATION OF—WITH SPECIAL REFERENCE TO THE PHOTOMECHANICAL PROCESSES. E. Wolff. *Reproduktion*, Dec. 1936, P. 205–8; abs. in *Eastman Kodak Abs. Bull.*, Jan. 1938.

The preparation of print rolls with uninterrupted screening is difficult. During the twentieth century, photomechanical methods of doing this have developed along two main lines, namely, the transfer of resist images, and sensitization of the cylinder itself. Patented processes, representing successive improvements in technique, are reviewed. (S)

Work of the Manchester (Eng.) Testing House. *Tex. Mfr.*, March 1938, P. 99.

Some examples of defects in yarns, fabrics, and goods described in annual report. (C)

Yarns: Fancy and Novelty. H. Melton. *Tex. Mfr.*, April 1938, P. 139.

Examples are given of the methods of production of fancy twisted yarns, nep, down, streak, tinsel, and other yarns of worsted character, using spun-silk (schappe) and worsted machinery. (C)

III. Chemical and Other Processing (Not Otherwise Classified)

Acetate Rayon and Its Treatment During Dyeing. Richard Kahl. *Spinner u. Weber*, 1937, V. 55, No. 44, P. 39–43; abs. in *C. A.*, 1938, V. 32, Col. 1459.

Chem. and mech. treatments are described and directions are given for dyeing with Celliton fast and Celliton dyes. The resistance to rubbing of acetate dyeings is improved by soaping. (W)

Aniline Dyeings: Change to Green of. Bedu. *Klepzig's Textil-Z.*, 1937, V. 40, P. 653; abs. in *C. A.*, 1938, V. 32, Col. 1458.

Describes a method of preventing by thorough oxidation. (W)

Bleached Cotton, Rayon and Staple Fibre: Dye Absorption. Drathen, Havekost and Ruscheweyh. *Mell. Textilber.*, 1937, V. 18, P. 915–18; abs. in *J. T. I.*, Feb. 1938, P. A84. (C)

Brenthol Mixtures: Application. H. Blackshaw. *J. Soc. Dyers Col.*, 1937, V. 53, P. 373–6; abs. in *J. T. I.*, Jan. 1938, P. A25.

Although the available coupling components give nearly 2,000 possible pairs in azoic dyeings, it is frequently necessary to use mixtures to get a desired shade. Difficulties due to wide differences in coupling power are likely to be experienced if developers are mixed and the author recommends the use of one developer with a mixture of Brenthols or Naphthols. A table is arranged to show what pairs of Brenthols give satisfactory results and what combinations give trouble. The use of mixtures demands care in the calculation of quantities, as in the conversion of laboratory recipes to bulk dyeing, in the translation from one liquor/goods ratio to another, or in the determination of correct feeding quantities for standing baths. Such calculations are discussed and discrepancies are mentioned. (C)

Cellulose Acetate: Recent Treatments of Fabrics Containing. Jean Rolland. *Rev. gen. mat. color.*, 1937, V. 41, P. 500–5; abs. in *C. A.*, 1938, V. 32, Col. 1104.

This covers the use of Aniline Black, Chrome and Rapidogen colors, especially Aniline Black. (W)

CELLULOSE ETHERS AND THEIR USE IN PLACE OF GLUE AND STARCH IN THE TEXTILE INDUSTRY. F. Ohl. *Kunstdünger u. Leim*, 1937, V. 34, P. 188–90; abs. in *C. A.*, 1938, V. 32, Col. 1105.

Application possibilities and advantages are briefly reviewed. (W)

CELLULOSE FIBRES: IMPROVEMENTS IN SYNTHETIC DETERGENTS WITH SPECIAL REFERENCE TO. Georg Schulz. *Mell. Textilber.*, (German edition) 1938, No. 4, P. 363. (C)

COTTON DYES: MODERN VIEWS ON THE SUBSTANTIVITY OF. Rümmler. *Spinner u. Weber*, 1937, V. 55, No. 48, P. 6; abs. in *C. A.*, 1938, V. 32, Col. 1101.

The salts of sulfonic and carboxylic acids used as substantive cotton dyes are highly dissocs., good conductors of electricity and poly-dispersed (containing particles varying from mol. to colloidal size). The adsorption of these dyes by cellulose is due to elec. forces between dye and cellulose. As both substantive dye particles and cellulose in water are neg. charged the repulsion between them is overcome by the addn. of salts which decrease the neg. charge and allows the local forces of attraction between fibre and dye to act. No definite relationships were found between particle size and dyeing power. Substantivity depends on soly. of the dye in water; *i.e.*, the dye must contain groups which can hold large amts. of water mols. If, however, there are too many of these groups the affinity to the water becomes so great that the substantivity is diminished. Increasing mol. size enlarges mol. cohesion forces. The dyeing can be rendered more highly resistant to water by aftertreatments as *e.g.*, after diazotization and developing; these operations enlarge the dye mol. and thus increase its mol. cohesional forces and substantivity. (W)

DESIZING AGENT. E. Meissner. *Deut. Wollen-Gewerbe*, 1937, V. 69, P. 1479–80; abs. in *C. A.*, 1938, V. 32, Col. 1467.

A discussion dealing with sizes contg. starch products, protein compds. and oils. (W)

DYEING AND FINISHING SILK AND RAYON HOSE. D. Martin. *Dyer*, 1937, V. 78, P. 167–9, 215–7, 269; abs. in *C. A.*, 1938, V. 32, Col. 1460.

The processing of the following kinds of hosiery is considered: silk, silk and cotton, viscose rayon and cotton, acetate rayon and cotton, and cuprammonium rayon and cotton. (W)

DYEING ASSISTANTS WITH IMMEDIAL DYES: USE OF. H. Hansen. *Klepzig's Textil-Z.*, 1937, V. 40, P. 594; abs. in *C. A.*, 1938, V. 32, Col. 1458. (W)

DYEING COTTON AND HALF-WOOL TO BLACK AND GRAY SHADES WITH LOGWOOD. M. Aymondin. *Tiba*, 1937, V. 15, P. 227–31, 307–13; abs. in *C. A.*, 1938, V. 32, Col. 784.

Logwood is inexpensive and it causes no alteration of the fibres, such as may result from sulfur blacks. The latest processes are discussed. (W)

DYEING OF MIXED YARNS FROM WOOL AND STAPLE RAYON. Richard Kahl. *Monatschr. Textil-Ind.*, 52, Fachheft II, P. 56–7 (1937); abs. in *C. A.*, 1938, V. 32, Col. 1459.

A detailed discussion of the use of anthralan, sirius, sirius light, benzo, benzo fast, metachrome, acid, immedial leuco and afterchrome dyes. Dyeing directions are given and numerous dyes are listed which are suitable for the dyeing of mixed yarns from wool and staple rayon. (W)

DYEING RAYON. H. H. Mosher. *Can. Chem. Met.*, 1937, V. 21, P. 331–3, 339; abs. in *C. A.*, 1938, V. 32, Col. 361.

The micellar structure of rayon in relation to dyeing is discussed. The scouring operation and the dyeing of rayon together with the recent auxiliaries are included. (W)

ETHANOLAMINES IN THE TEXTILE INDUSTRY: APPLICATIONS OF. Anon. *Klepzig's Textil-Ind.*, 1937, V. 40, P. 663–4, 670–1; abs. in *C. A.*, 1938, V. 32, Col. 1457.

A discussion of 25 patents and literature references. Numerous recipes are given. (W)

EVALUATION OF FASTNESS TO LIGHT. Asu Vendor. *Monatschr. Textil-Ind.*, 1937, V. 52, P. 262; abs. in *C. A.*, 1938, V. 32, Col. 1458.

The fastness to weather should be considered in addn. to the fastness to light. Vat dyeings of light fastness 6 exhibit values of permanency which differ from those of substantive dyeings of equal light fastness no. This is borne out by the fact that when substantive and vat dyeings of equal light fastness are subjected to the weather without a protective glass plate the substantive dyeing will fade quickly while the other one will retain its color. V. suggests that a standard be adopted for interrelating fastness to light and to weather. (W)

FINISHING AND DYEING OF VELVET. O. Heinsdorf. *Klepzig's Textil-Z.*, 1937, V. 40, P. 605–6; abs. in *C. A.*, 1938, V. 32, Col. 1460.

Various chem. and mech. treatments are described. (W)

FINISHING OF GOODS MADE PARTLY OR WHOLLY OF STAPLE RAYON. Krüger. *Klepzig's Textil-Z.*, 1937, V. 40, P. 652; abs. in *C. A.*, 1938, V. 32, Col. 1466.

The finishing of pure staple rayon is similar to that of cotton or rayon goods. The chem. treatment of a mixt. of wool and staple rayon should be like that of woolen goods; with increasing staple-rayon contents the mech. treatment should approach that for cotton or rayon. The necessary procedures are outlined in detail. (W)

FORMALDEHYDE: APPLICATION IN NAPHTOL DYEING. P. W. Neber. *Angew. Chemie*, 1937, V. 50, P. 411; abs. in *J. T. I.*, Feb. 1938, P. A84.

Evidence is advanced that the restraining effect of formalin in Naphtol padding liquors is due to the formation of a methylol compound, $OH.CH_2.C_{10}H_5(OH).COONHPh$. On the addition of the diazonium salt, coupling takes place in position I, formaldehyde being expelled. (C)

PROTECTIVE MEASURES IN THE TEXTILE-FINISHING INDUSTRY AGAINST UNDESIRABLE CHEMICAL REACTIONS OF STRUCTURAL MATERIALS. H. W. Schulz. *Monatsh. Seide Kunstseide*, 1937, V. 42, P. 389–91, 431–3; abs. in *C. A.*, 1938, V. 32, Col. 1103.

A discussion of methods of overcoming (1) chem. hazards from acid and alk. liquids and fumes of various compn., concn. and temp. and (2) phys. hazards due to friction, impacts, pressure, temp. and temp. changes. (W)

RAYON BOIL-OFF WASTE: TREATMENT OF. Foster D. Snell. *Ind. Eng. Chem.*, 1937, V. 29, P. 1438–9; abs. in *C. A.*, 1938, V. 32, Col. 787.

Rayon boil-off liquor from the plant studied contains soap, Na_2CO_3 and mineral oil at about pH 10.6. Coagulation methods are unsatisfactory. Acid treatment and centrifuging entail expensive equipment. Pptn. with 2–4 lb. of 75% $CaCl_2$ per 100 gal. is satisfactory, but commercially filtration through ashes proved adequate. A bed of 30 tons treats one million gallons and removes about 6500 lb. of oils and 1500 lb. of soap, Na_2CO_3, etc. (W)

RAYON: FAST PRINTING ON. P. Rivière. *Rusta-Rayonne*, 1937, V. 12, P. 425–30; abs. in *C. A.*, 1938, V. 32, Col. 1459.

A description of the steam, nitrite, dichromate and $Al(ClO_3)_3$ processes of printing rayon with indigosol, rapidogen and fast-rapid dyes. (W)

SCREENS FOR SCREEN PRINTING: A FEW FACTS ABOUT. Albert Franken. *Mell. Textilber.* (German edition), 1938, No. 4, P. 370.

The present article describes in detail the practical preparation of printing screens by the photo-chemical method and refers to the approved apparatus used for the purpose made by Messrs. Hoh & Hahne, of which several illustrations are given. (C)

SOAP AND SOAP-LIKE SUBSTANCES. Ernst Kraus. *Wollen- & Leinen-Ind.*, 1937, V. 57, P. 265–6, 283–4; abs. in *C. A.*, 1938, V. 32, Col. 364.

A review dealing with wetting, foaming and emulsifying properties, protective colloidal action, washing with hard water, Ca compds. of synthetic washing agents, washing in the presence of Calgon, economy of the softening of water and chem. control of washing procedures on a large scale. (W)

SULFURIC ACID AND SULFATES IN WOOL. L. Armand. *Tiba*, 1937, V. 15, P. 283–9; abs. in *C. A.*, 1938, V. 32, Col. 786.

A method is given for the detn. of free acid in wool as this is very important in the control of dyeing, carbonization and bleaching. (W)

TEXTILE PRINTING ASSISTANTS. A. J. Hall. *Canadian Text. J.*, 1938, April 15, P. 37–9; May 13, P. 40–2.

A summary of present day knowledge of the chemistry of several new types of auxiliaries which find application in textile printing, and the author's views as to the trend of future developments. (C)

UNSHRINKABLE WOOL. *Dyer*, 1937, V. 78, P. 577–8; abs. in *J. T. I.*, Feb. 1938, P. A87.

The disadvantage of wet chlorination is the difficulty of obtaining uniform treatment of all the fibres, the usual result being over-treatment of the fibres on the surface of the yarns, while the fibres in the interior may remain untreated. The use of dry gaseous chlorine (W. I. R. A. process) or of sulphuryl chloride in an organic solvent (Dri-Sol process) results in the uniform treatment of all the fibres. (C)

VISCOSE RAYON: MASS DYEING OF. G. Lepage. *Tiba*, 1937, V. 15, P. 559–63; abs. in *C. A.*, 1938, V. 32, Col. 1459.

A brief pat. review, showing the difficulties (practically insurmountable) encountered with the early processes and showing that the problem has been satisfactorily solved by the Dosne pats. (W)

WATERPROOFING TEXTILES: PREPERATION OF AQUEOUS RUBBER EMULSIONS FOR. W. Pratt. *Tiba*, 1937, V. 15, P. 501–7; abs. in *C. A.*, 1938, V. 32, Col. 788.

A discussion of the mechanism of the emulsification of rubber, with practical operating directions for obtaining optimum results. (W)

WOOL: PRACTICE AND THEORY OF THE ACTION OF THIOCYANATES ON. Ed. Justin-Mueller. *Rev. gen. mat. color.*, 1937, V. 41, P. 419–22; abs. in *C. A.*, 1938, V. 32, Col. 1103.

The thiocyanates imprinted on wool in acid solns. have no action, being simply transformed into thiocyanic acids. But in neutral or slightly alk. solns., they become sulfhydrates during steaming, which shrink chlorinated wool, because of its metakeratin, and superficially after nonchlorinated wool. (W)

WOOL: RESERVE TREATMENT OF. Bedu. *Klepzig's Textil-Z.*, 1937, V. 40, P. 729–30; abs. in *C. A.*, 1938, V. 32, Col. 1458.

Directions are given for the use of "Wollreserve CB," manufd. by the I. G. Farbenind. (W)

IV. RESEARCH METHODS AND APPARATUS

CALCIUM THIOCYANATE METHOD FOR THE DETERMINATION OF STAPLE RAYON. H. Rath and A. Agster. *Klepzig's Textil-Z.*, 1937, V. 40, P. 617–19; abs. in *C. A.*, 1938, V. 32, Col. 1463. (W)

COLOR: PRESENT STATUS OF THE MEASUREMENT OF. A. v. Lagorio and E. Ristenpart. *Mell. Textilber.*, (German edition) 1938, No. 4, P. 361.

Devoted in large part to the Ostwald theory and method of color measurement, the Pulfrich photometer, and the use of the photo-electric cell to replace the eyes and ensure accuracy of measurement. Numerous literature references are given. (C)

COLOR MEASUREMENT IN THE DYESTUFF INDUSTRY WITH SPECIAL REFERENCE TO FASTNESS TESTS. I. H. Godlove. *Am. Dye. Rptr.*, Mar. 21, 1938, P. 148–56.

Paper presented at Annual Meeting of A. A. T. C. C., Philadelphia, Dec. 4, 1937. (C)

COPPER AND MANGANESE: DETERMINATION IN CLOTH. W. Hiltner. *Z. anal. Chem.*, 1937, V. 110, P. 241–51; abs. in *J. T. I.*, Jan. 1938, P. A44.

Present German methods for determining Cu and Mn in cloth for rubber proofing are examined and shown to need improvement in the procedure for decomposing the test specimen. Details are given of a scheme of analysis in which the specimen (10 gm. if possible) is decomposed by means of sulphuric and nitric acid, Cu is determined electrolytically if much is present or colorimetrically by means of sodium diethyldithiocarbamate or pyridine and thiocyanate, and Mn is determined colorimetrically as permanganate after oxidation with persulphate. Check analyses on unrubbered fabric containing known amounts of Cu gave concordant results. On rubbered fabrics the new procedure gave significantly higher Cu and Mn contents than the "Logufa" method (Vereinigung Deutscher Lohngummierungsfabriken). (C)

FIBRE LOAD-EXTENSION DIAGRAM RECORDING DEVICE. P. Chevenard. *Revue Text.*, 1937, V. 35, P. 447, 449; abs. in *J. T. I.*, Jan. 1938, P. A39.

A small device for recording photographically the load-extension diagrams of single fibres is shown in photographs and described briefly. Fibres of 1 mm. to 10 mm. length may be tested. The device comprises a three-legged amplifier with mirror, the three points of which form a right-angled triangle. The point of the right angle undergoes, in a direction normal to the plane of the three points, a displacement equal to the deflection of a spring to which the fibre is attached; another point accompanies in its displacement the movable clamp which extends the fibre; the third point is fixed. The movable clamp is driven by an electric motor; several speeds are possible. Curves obtained for ramie, wool, silk, viscose and cellulose acetate rayon fibres are given. (C)

FIBRE WEBS: STRENGTH. P. Eckert and H. Hoffmann. *Spinner u. Weber*, 1937, V. 55, No. 44, P. 26–8; abs. in *J. T. I.*, Jan. 1938, P. A39.

A method is described for determining the power with which textile fibres adhere or cling together (a property connected with their spinning capacity). It depends on the preparation of a web with the usual carding apparatus and measurement of the strength of a strip of the web of given weight and dimensions. The strip is held between a lower fixed clamp and an upper movable clamp which is attached to two cords. The cords pass round two pulleys at the top of a frame and the ends hanging down the back of the frame are attached to suitable weighting means. Results obtained in tests on wool and viscose staple fibre after 2, 4 and 8 carding treatments are tabulated and discussed, and it is pointed out that the web strengths decrease with increasing number of passages through the card. The results of tests after carding and then after allowing a period for recovery are also given. A special viscose staple fibre showed a power of

recovery very similar to that of wool but ordinary viscose staple fibre showed practically no power of recovery. (C)

Loop Strength (Testing of Yarns). A. C. Clifford. *Tex. Wld.*, Dec. 1937, P. 95.

Although the author confines himself to the specific problem faced by his company, the method of testing which he describes has interesting possibilities along other lines. Where yarn, thread, or twine is subjected to a cutting action upon itself, the loop-strength method of testing approaches much nearer the condition of use than the standard tensile-strength test. Lacing, chain stitching, and bundle tying are obvious cases where the method is applicable; and there is a large field in knitting yarns, since the knitted fabric is essentially nothing but a series of loops pulling against one another. (C)

Oil, Soap and Other Extraneous Matter in Textile Materials: Methods of Determining. II. Investigation of the Nature of the Material Obtained by the Extraction of Wool with Ethyl Alcohol. Bertil A. Ryberg. *Am. Dye. Rptr.*, Jan. 10, 1938, P. 8–13.

Approximately the same amount of alcohol extractable material can be obtained from solvent process scoured wool, which has had no contact with soap, as from wool scoured with soap and sodium carbonate. In the above cases, 1.1% and 1.2% respectively of alcohol extractable material was obtained, based on the dry weight of the wool. In the case of soap scoured wool, less than one-half of the alcohol extract is actually soap. The fact that there was no free fatty acid for the soap scoured wool, suggests that the free fatty acid in raw wool was neutralized by the added alkali in the scouring bowl to form soap. Esters of the higher alcohols form a large part of the alcohol extract, the remainder being mostly free acids of equivalent weight 254. These free acids may possibly be connected with the nitrogen found in this alcohol extract. This suggests that the alcohol has removed actual wool substance. A logical outcome of this investigation would be the development of a reliable method for determining soap in wool. Such a method would be of considerable value as a means of control for scouring processes. (C)

Testing the Running Thread. Walter Frenzel. *Mell. Textilber.*, 1938, No. 3, P. 233.

It has hitherto been customary to base an opinion of the working qualities of yarn mostly upon its tensile strength, but it has been discovered that it is at least equally important to determine the elongation. The author has designed a testing apparatus in which the running thread is examined and in which elongation is placed in the foreground. It is possible to determine with the aid of a yarn testing machine with constant load on the thread whether any part of its whole length fails to come up to a definite minimum strength. Any breakages of the thread are recorded, and their distribution permits of conclusions as to their cause and the working qualities of the yarn. Tests carried out with constant elongation permit of determining the minimum elongation limit. The tests can also be carried out below the thread breakage limit in order to obtain information as to the properties of the yarn at that elongation to which it

will be subjected in the loom. By that means variations in the denier and elongation of rayon are made evident, as well as spindle rail play, deficient elongation in ring-spun yarn from the cop-bit or from the nose of the cop. (C)

V. Economics, Physics and Miscellany

Color: Measurement. J. Guild. *Trans. Illum. Engng. Soc.* (*London*), 1937, V. 2, P. 128–34; abs. in *J. T. I.*, Jan. 1938, P. A51.

A report of a lecture on the relation of colorimetry to photometry. It is shown that there is complete correlation between the physical structure of light as described by its spectral energy distribution and its color quality on a trichromatic system, through the medium of three functions of wave-length, similar in character to the one function of wave-length that photometrists know as the visibility function and related to the latter by the luminosity factors of the three trichromatic standards. A trichromatic colorimeter is therefore a universal heterochromatic photometer, in which all matches are made without any difference of color in the matching field. In colorimetry what is actually evaluated is a property of radiation that can be described by three independent functions of wave-length and these three functions are determined in the first instance from measurements made with a trichromatic colorimeter. The use of radiometers consisting of thermopiles or photo-electric cells in conjunction with filters for measuring the colorimetric constants of stimuli is also discussed. (C)

Contact Angles and Wetting. E. Kneen and W. W. Benton. *J. Phys. Chem.*, Dec. 1937, P. 1195–1203.

A simple, adequate horizontal-plate technique for determining contact angles in the system solid-liquid-air is described and its accuracy demonstrated. Applications of this method are illustrated and discussed with reference to (a) the evaluation of the wetting capacity of soaps, (b) the evaluation of the degree of polarity of surfaces, (c) the wetting properties of cholesterol toward water, (d) the wetting capacity of leaf surfaces, and (e) the wetting properties of tooth surfaces. (X)

Cotton Pectins: Extraction. M. M. Tschilikin and S. S. Rosowa. *Shurn. prikl. Chimii*, 1937, V. 10, P. 709–16; also *Chloptschatobumash. Prom.*, 1937, V. 7, No. 3, P. 37–41 (through *Chem. Zentr.*, 1937, ii, P. 2095); abs. in *J. T. I.*, Jan. 1938, P. A53.

The pectins present in cotton consist of araban, xylan and 0.46% of pectic acid, which yields on hydrolysis galacturonic acid, arabinose, xylose and fructose. The pectins are incompletely extracted by water at 98–100°, better by boiling under pressure. The extract contains galacturonic acid. Dilute soda and caustic soda remove the pectins completely but cause decomposition. (C)

Heat of Sorption of Solvents by Nitrocellulose. Part II. S. Papkov and V. Kargin. *Acta Physicochim.*, 1937, V. 6, No. 5, P. 667–82 (German).

Previous work is now continued, and the heats of sorption and isotherms are first determined during the sorption of ethyl alcohol and ethyl ether

by nitrocellulose. The heats of solution of nitrocellulose in binary mixtures (of ether-alcohol) have also been measured for various compositions. Experimental details are included. It has been established from the experimental data that a competition arises during the solvation between ether and alcohol. From the heat of solution curve the upper limit has been estimated of the energy of the reciprocal effect between the solvating particles themselves. Two possibilities of this reciprocal effect (and structure formation) are considered: (a) the existence of a large number of bonds with small energy, (b) the existence of a small number of bonds with large energy. The second possibility is regarded as the more probable. On the assumption that every chief valency chain only possesses two bonds (end groups), the reciprocal effect energy has the value of 12–15 kg. cal./mol. (X)

Book Review

ZELLWOLLE KUNSTSPINNFASERN. Dr. H. G. Bodenbender. Published by Chemischtechnicher Verlag Dr. Bodenbender Berlin-Steglitz (Germany). 2nd Ed., 261 illustrations, 680 pages and 56 charts. 1937. Price $6; reviewed in *Rayon Tex. Mo.*, Feb. 1938, P. 112.

This is the second edition of this book. It is a veritable encyclopedia on rayon staple fibre and its manufacture, converting and use. While in German, it is simply enough written to be understood by most people who have only a cursory knowledge of the language. (C)

(*Continued from page 309.*)

Synthetic fibre made from the protein material of soy beans has been produced by the research department of Ford Motor Co. In the present experimental stage of its development it will not stand washing, but it has been used for webbing in automobile body construction.

* * *

Powdered wool, bleached and dyed in suitable shades and mixed with some 20% of rice starch, is now being used as a face rouge or eye-shadow, according to the *Manufacturing Perfumer.* As to why wool, rather than some other fibre, is preferred for cosmetic purposes is not clearly explained, although it is interesting to know that it can be partially hydrolyzed and powdered. Neither is it stated whether "virgin" or "recovered" wool is preferred, nor whether the wool face powder is moth-proofed.

* * *

Chinese shirt tails increased in length by a few inches was advocated years ago by a Lancashire, England, cotton manufacturer to take up the slack in cloth production. According to Major H. A. Proctor, a Japanese adaptation of this idea is being used to circumvent import quotas of the Malay States on cotton piece goods. In the House of Commons recently he stated that the Japanese are shipping in cotton shirts with tails several yards long, thus allowing surplus yardage of tails to be cut off and sold as piece goods.